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Veterinary Services

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National Johne's Disease Demonstration Herd Project

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Cover photo by Jason Lombard

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Background and justification

Goal II of the Report of the Ad Hoc Steering Subcommittee of the United States Animal Health Association Committee on Johne's Disease (2002) was "to define critical knowledge gaps that influence producer participation (in the control program) and affect Johne's disease control." One objective under this goal was "to develop and validate model strategies for control of Johne's disease," further stating that "demonstration herds … are critical and of the highest priority to provide the validated management tools to implement a science-based National Johne's Disease Program."

In late 2003, the National Johne's Disease Demonstration Herd Project (NJDDHP) was funded, and operations were selected for participation by project investigators. Minimum requirements for operations participating in the project included the isolation of *Mycobacterium avium* subspecies *paratuberculosis* (MAP)—the causative agent of Johne's disease—from an animal or the farm environment. Operations agreed to have an annual risk assessment and management plan performed, as well as share records on the health, production, and movement of their animals with investigators. Investigators submitted data collected from these operations—including the results of individual and environmental testing for MAP— to USDA's National Animal Health Monitoring System.

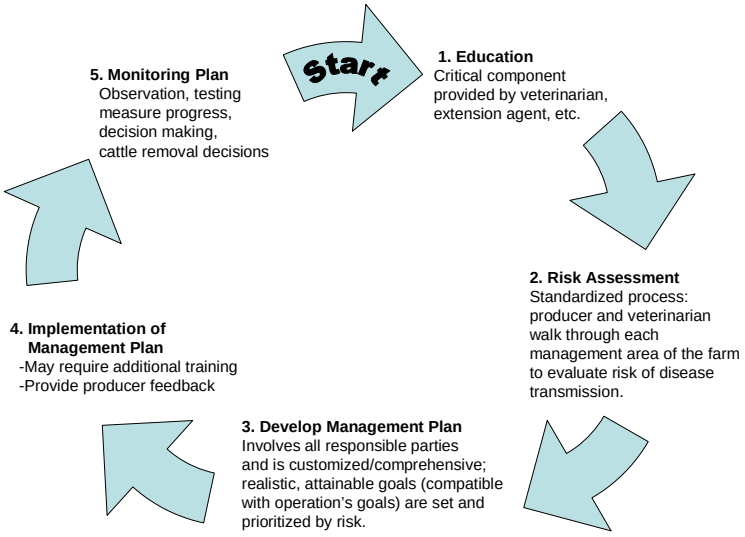
The primary objective of the NJDDHP is to evaluate the long-term feasibility and effectiveness of management-related practices designed to control MAP infection on dairy and beef cattle operations. To this end, information is being gathered to: 1) determine and monitor risks based on current management practices; 2) estimate the prevalence of infection from individual animal fecal culture and/or serum ELISA testing; 3) quantify the incidence of clinical disease by lactation number; and 4) monitor Johne's disease test status of cattle removed from operations. The project will continue for a period of 5 to 7 years, if funding is available.

With the assistance of project investigators, beef and dairy producers complete the risk assessment, which allows for quantitative and qualitative evaluation of management areas and practices most likely associated with MAP transmission. The areas evaluated include calving area, preweaned (nursing) calves, postweaned calves, yearling animals, mature animals, and herd additions. Each of these areas is assigned a different total possible risk score based on the potential transmission of MAP.

From the risk assessment, producers and investigators develop a management plan to address the specific areas highlighted by the risk assessment. Interventions focus on reducing or eliminating oral ingestion of manure to limit MAP transmission. Individual animal testing is an important component of the project to evaluate the effect of management practices on the within-herd prevalence of MAP. This project also provides an opportunity to evaluate environmental sampling as a method of determining herd infection status.

The five primary components of the Johne's Disease Control Plan are outlined in figure 1. Producer education is the starting point of the plan and is considered the critical component. However, it is important to note that the process requires producer involvement in all phases. To measure progress and identify any necessary modifications to the plan, an annual review is conducted.

Figure 1. Johne's Disease Control Plan (Annual Process)



Producer involvement required in all steps

Current status of project

As of May 2005, the project completed its second full year of monitoring, testing, and data collection; 18 states participated (figure 2). Currently, 23 beef herds and 70 dairy herds are enrolled in the project, accounting for approximately 6,000 and 60,000 mature cattle (2yrs or older), respectively. Participating beef herds range from 35 to over 700 mature cattle. Participating dairy operations range in size from 70 to over 4,000 lactating cows. The largest percentage of both beef and dairy herds consists of herds with 100 to 499 mature cattle (figure 3).

Figure 2. States Participating in NJDDHP in 2005

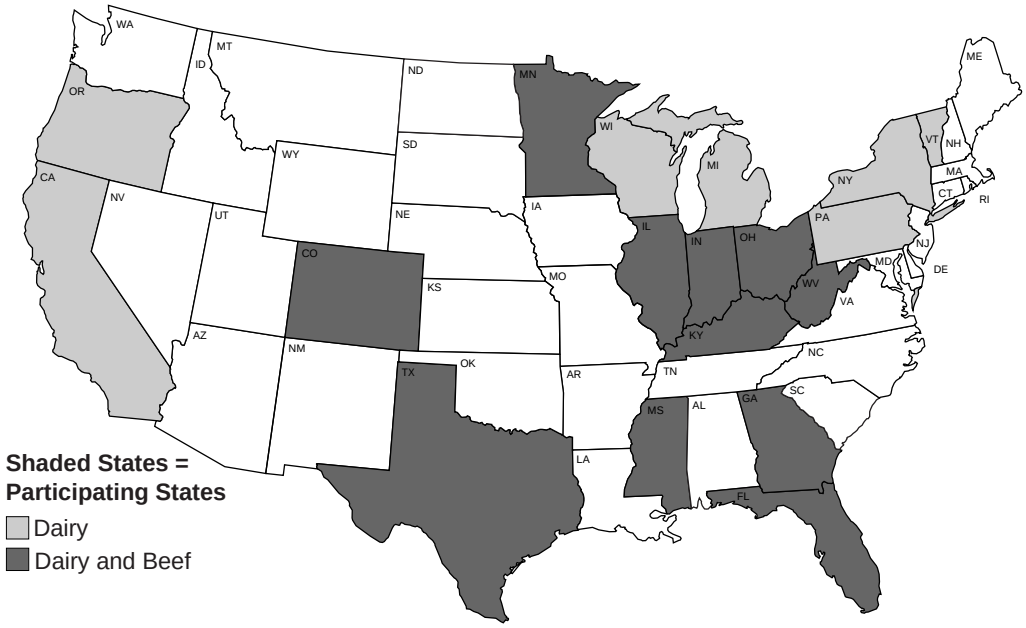
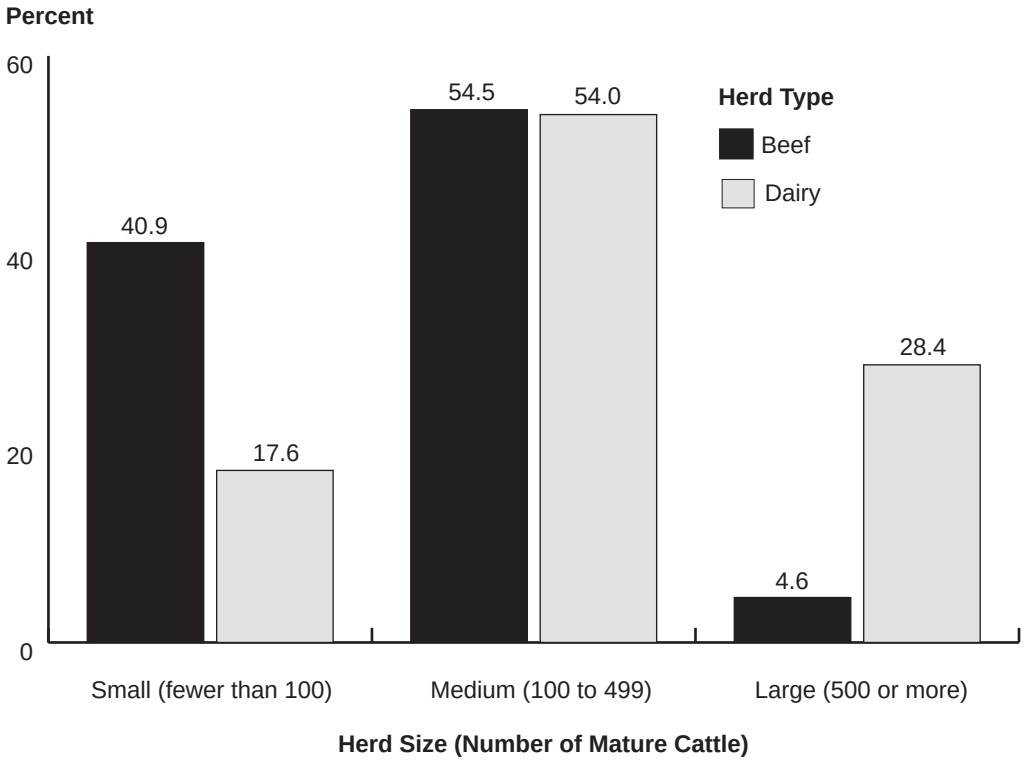


Figure 3. Percentage of Operations by Operation Type and by Herd Size



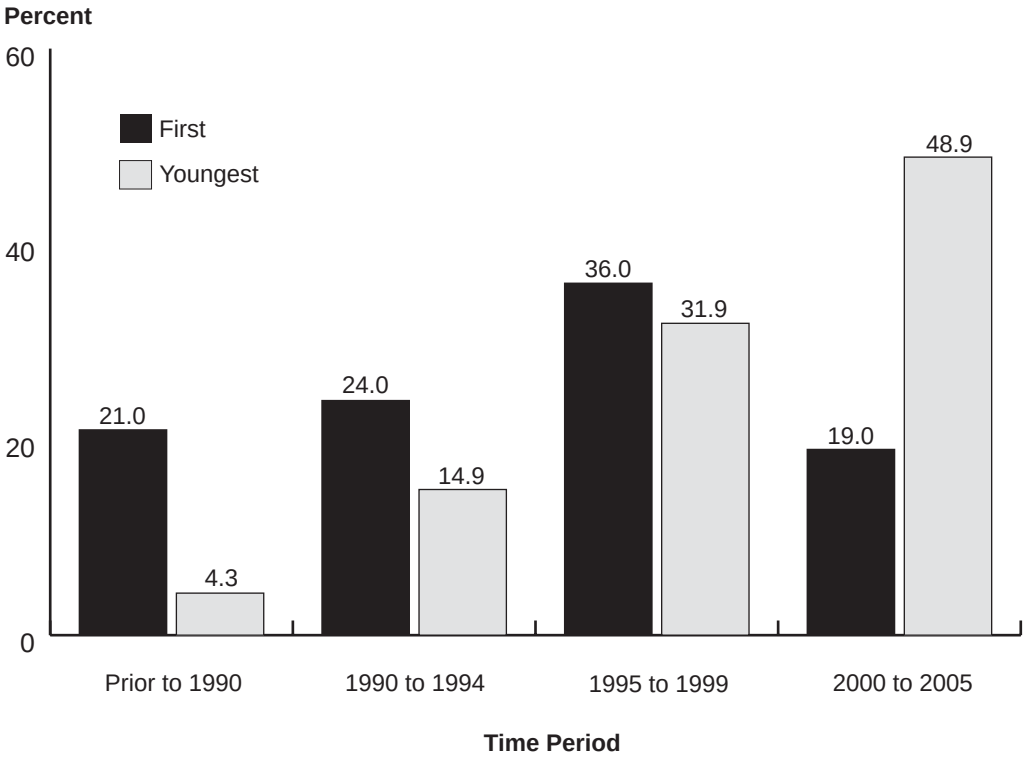
The largest percentage of enrolled beef cattle was of mixed breed (76.0 percent). Santa Gertrudis and Brahman represented the remaining 20.0 percent and 4.0 percent of the beef cattle population, respectively. Holsteins represented the majority of dairy cattle (78.0 percent), while Jerseys accounted for 9.0 percent. Other cattle listed on dairy operations (13.0 percent) were not identified by breed.

The majority of operations (90.0 percent) had been in business prior to 1996. The oldest operation began in 1833, while five herds started business after 1999.

Herd history of Johne’s disease

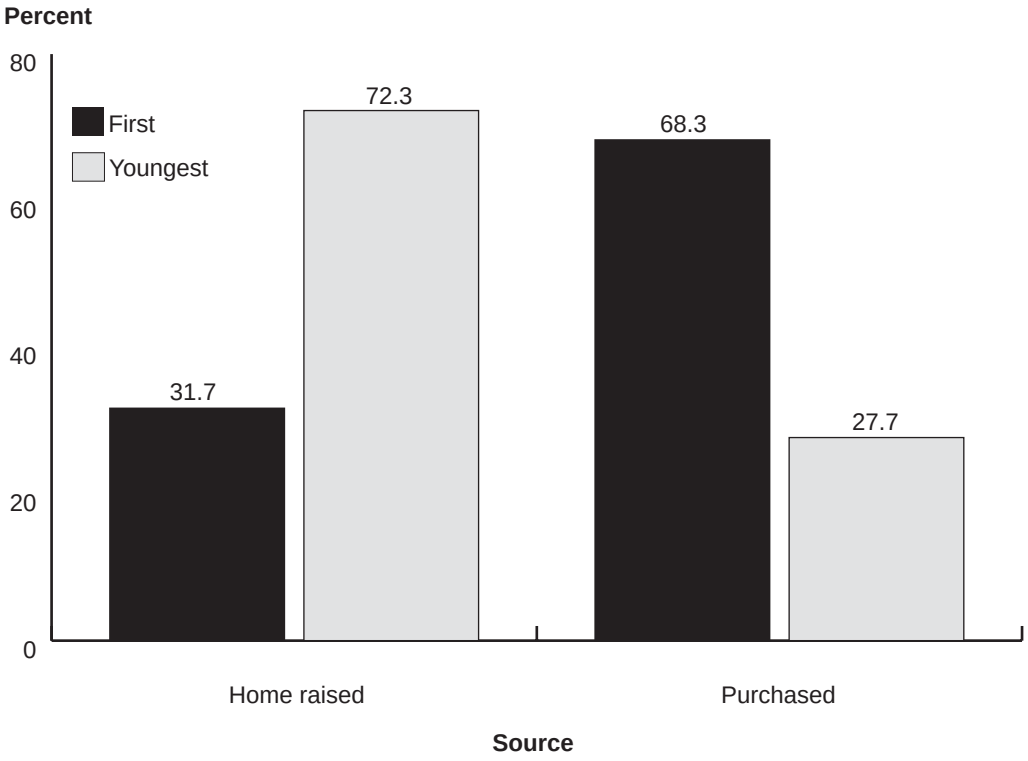
Most participating operations reported that the first animal that displayed clinical signs of Johne’s disease was observed from 1995 to1999 (figure 4). The median age of the first observed cases was 48 months and ranged from 24 to 132 months. Almost half of operations (48.9 percent) reported that the youngest clinical case was observed from 2000 to 2005. Potential reasons for recently observing the youngest case, compared to the first case, include better detection and recognition of the disease by producers, number of years the operation has been in business, and the possibility that animals are showing clinical signs at an earlier age. The median age of the youngest cases reported was 24.0 months with 15 months being the youngest age reported.

Figure 4. Percentage of Operations by Time Period that First and Youngest Animals with Clinical Signs of Johne's Disease were Observed



The source of the first animal to display clinical signs consistent with Johne's disease was most frequently a purchased animal (68.3 percent of operations), while the youngest animal to display clinical signs was most commonly a home-raised animal (72.3 percent of operations) (figure 5).

Figure 5. Percentage of Operations by Source of the First and Youngest Animals to Display Clinical Signs of Johne's Disease



Beef operations
Risk Assessment

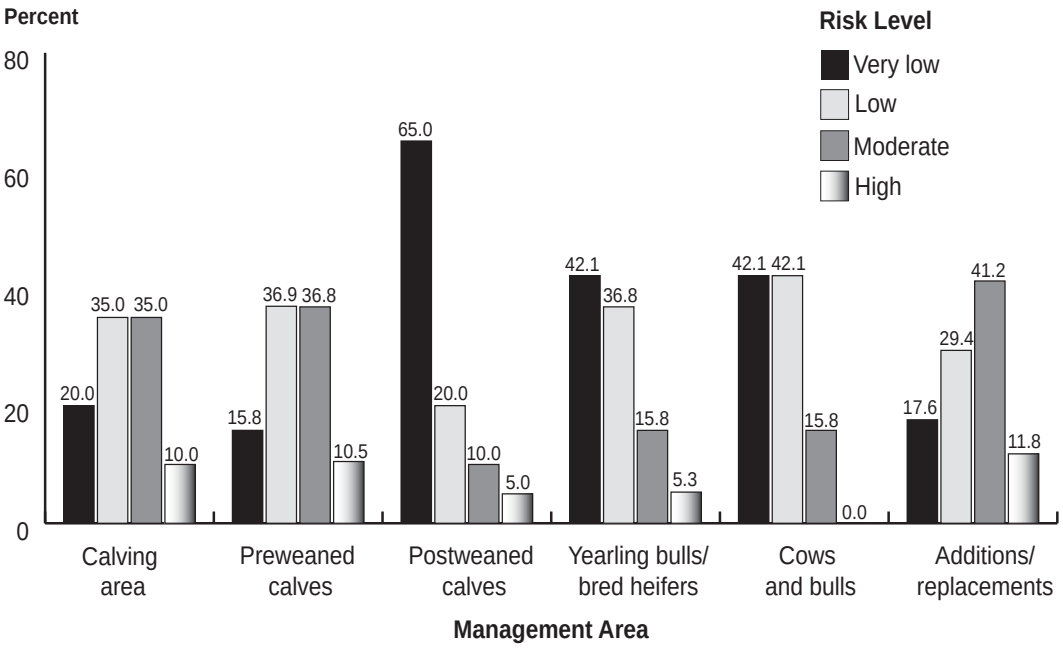
Table 1 presents risk management areas, average total risk scores, and maximum possible risk scores for beef operations. An average total risk score was calculated after combining results of the first risk assessment performed from all participating beef operations. Within each risk management area, several contributing risk areas were assessed (scored). Overall average total risk score for beef operations was 62.8. The addition/replacement management area had the highest score (19.1), followed by preweaned calves and calving areas (12.0 and 11.9, respectively).

Table 1. For the initial assessment, average total risk score and maximum possible risk score for beef operations, by risk management areas

Risk Management Area	Average Total Score	Maximum Possible Score
Calving area	11.9	40
Preweaned calves	12.0	50
Postweaned calves	4.8	35
Yearling bulls and heifers	6.4	25
Cows and bulls	3.8	16
Additions/replacements	19.1	60
Overall average total risk score	62.8	226

After assessing each management area and assigning a risk score, a qualitative estimate (risk level) of the likelihood of MAP transmission was assigned by the investigator. No participating beef operations were estimated to be at very high risk for transmitting MAP in any of the areas evaluated: 20.0 percent of beef operations had a very low estimated risk in the calving area and 65.0 percent were at very low risk for MAP transmission in the management of postweaned calves (figure 5).

Figure 6. Percentage of Beef Operations by Estimated Risk Levels in the Following Management Areas



For beef operations, the preweaned calves management area had the second highest average total risk score of all areas. Figure 7 shows an excerpt from the risk assessment used for evaluating the preweaned calves area.

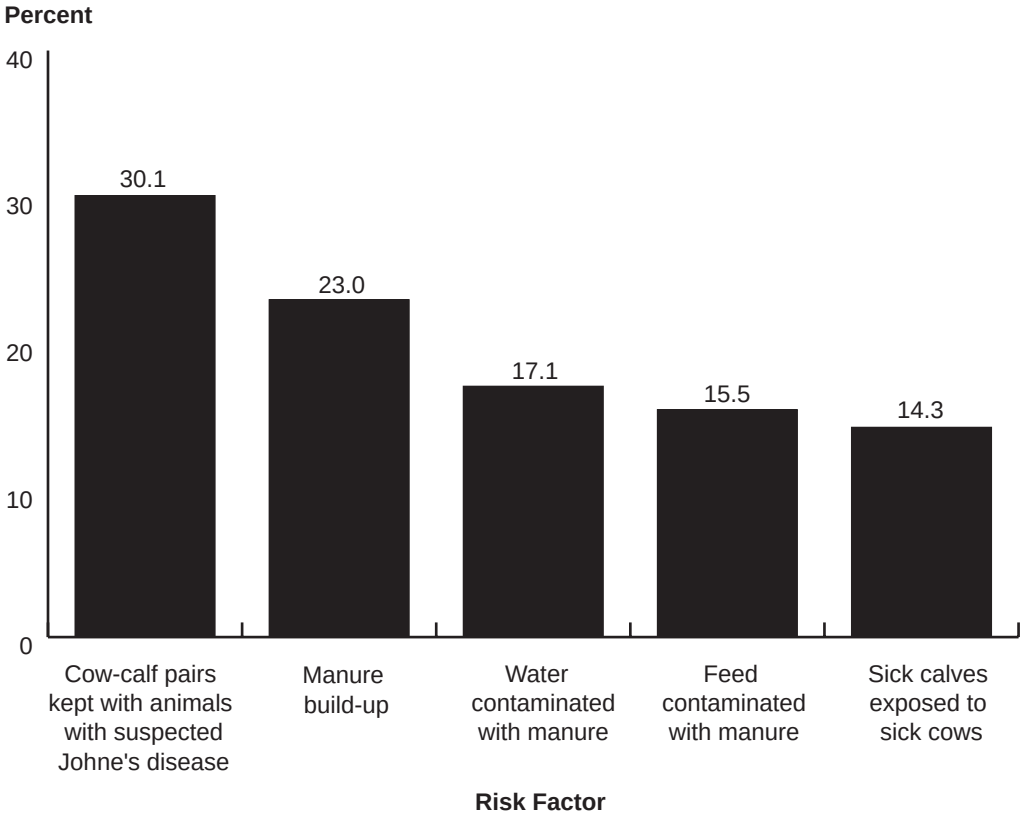
Figure 7. Example Risk-Assessment Form for Preweaned Calves

B. Nursing Calf Risk Factors (Place an X in the box to the right of the management practice that most closely signifies the risk for that item.)	0.	1 V. Low	2. Low	3.	4.	5 Moderate	6.	7.	8. High	9.	10. V. High
1. Cow/calf pairs kept with JD clinical or suspect animals [Never → Frequently]											
2. Manure build-up risk for calf ingestion [Clean dry → Dirty wet]											
3. Possible manure contamination of water by cows, traffic splatter, equipment or people [Never → Always]											
4. Possible manure contamination of feed by cows, traffic splatter, equipment or people [Never → Always]											
5. Sick calves exposed to sick cows [Never → Always]											

Maximum score is 50. Your herd score is _____. Consider the impact of JD prevalence on ability to reduce risks.
Estimate the risk for spreading Johne's in preweaned calves:
Very Low Low Moderate High Very High (circle choice)

The practice of keeping cow and calf pairs with animals that have clinical or suspected Johne's disease accounted for 30.1 percent of the preweaned calves area's average total risk score, while manure build-up accounted for 23.0 percent (figure 8).

Figure 8. For Beef Operations, Percentage of Preweaned Calves Management Area's Average Total Risk Score, by Risk Factor



Management plans

Results from the risk assessment were used to assist beef producers in developing a management plan to reduce MAP transmission. Of the 23 enrolled beef operations, 14 completed a written management plan. Management plans for beef operations focused primarily on segregating test-positive animals during calving and maintaining a clean calving area (9 of 14 operations). On 3 of 14 beef operations, screening replacement animals was the primary management focus.

Dairy operations
Risk Assessment

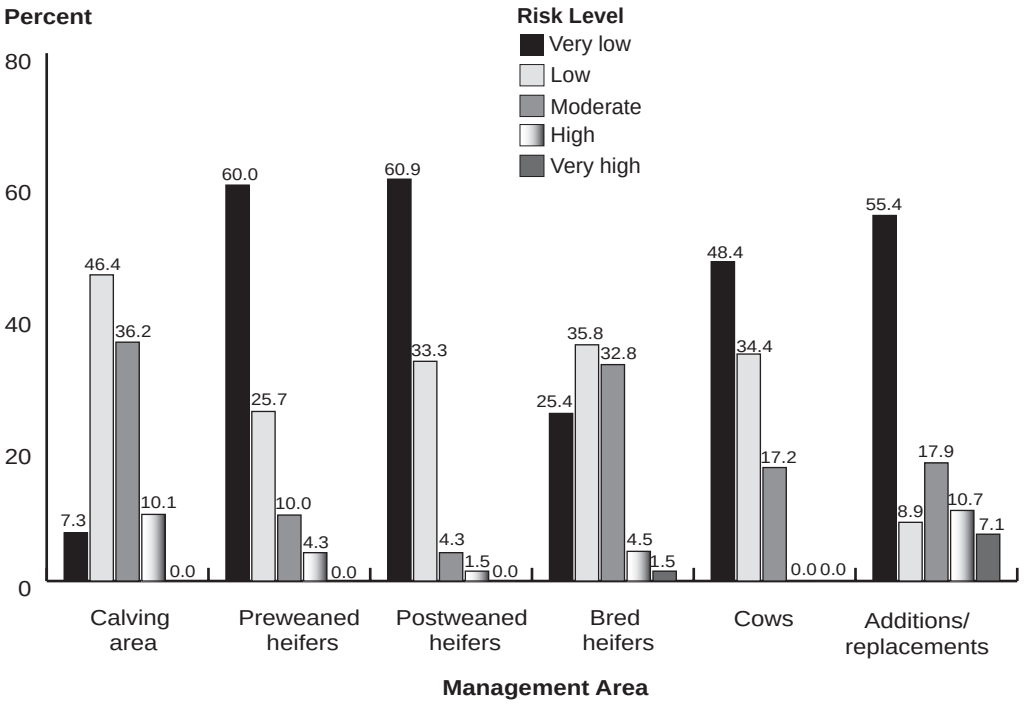
Table 2 presents risk management areas, average total risk scores, and maximum possible risk scores for dairy operations. Average total risk scores were calculated after combining results of the first risk assessment performed from all participating dairy operations. Within each risk management area, several contributing risk areas were assessed (scored). For dairy operations, the calving area was the largest contributor to the average total score (23.9), followed by the addition/replacement management area (13.5). Since these areas have higher maximum possible scores compared to other areas in the risk assessment, these results were expected.

Table 2. Average total risk score and maximum possible risk score for dairy operations, by risk management areas for initial assessment

Risk Management Area	Average Total Score	Maximum Possible Score
Calving area	23.9	80
Preweaned heifers	8.4	60
Postweaned heifers	4.6	35
Bred heifers	7.9	25
Cows	4.2	20
Additions/replacements	13.5	60
Overall average total risk score	62.7	280

A risk score was assigned by the investigator for each management area, and then a qualitative risk level was assigned to reflect the overall risk of MAP transmission. The qualitatively-assessed risk of MAP transmission in preweaned and postweaned heifers was very low on 6 out of 10 (60.0 percent and 60.9 percent, respectively) dairy operations (figure 9). A very small percentage of operations were at very high risk for MAP transmission. Bred heifers and additions/replacements were the two management areas assessed as being very high risk (1.5 percent and 17.1 percent of operations, respectively).

Figure 9. Percentage of Dairy Operations by Estimated Risk Levels in the Following Management Areas



The calving area is thought to be the most likely place for MAP transmission on dairy operations and had the highest maximum possible score, so it is no surprise that it had the highest average total risk score. Figure 10 shows an excerpt from the risk assessment used to evaluate the calving area.

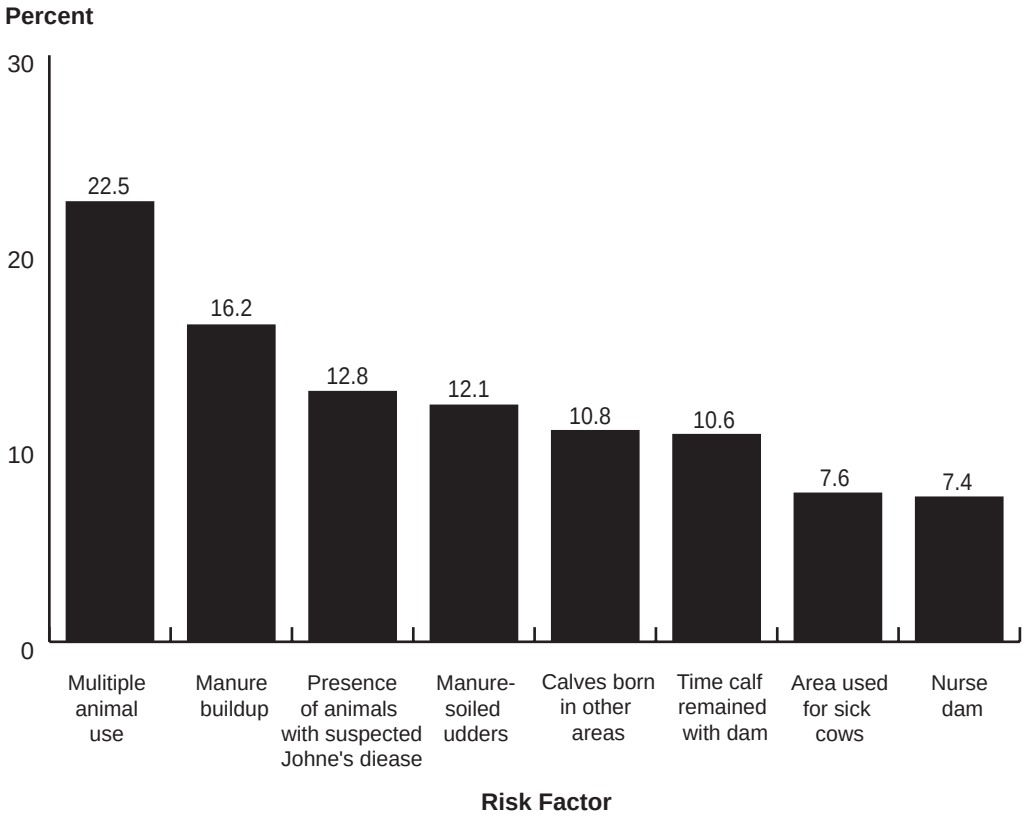
Figure 10. Example Risk-Assessment Form for Calving Area

A. Calving Area Risk Factors (Place an X in the box to the right of the management practice that most closely signifies the risk for that item.)	0.	1 V. Low	2. Low	3.	4.	5 Moderate	6.	7.	8. High	9.	10. V. High
1. Multiple animal use [Single pen → Dense crowded group]											
2. Manure build-up risk for calf ingestion [Clean dry → Dirty wet]											
3. Area also used for sick cows [Never → Always]											
4. Presence of JD clinicals / suspects [Never → Always]											
5. Manure soiled udders / legs [Never → Always]											
6. Calves born in other cow areas [Never → Always]											
7. Time calves stay with dam [<30 minutes → >24 hours]											
8. Calves nurse dam [Never → Most or all]											

Maximum score = 80. Your herd score is __. Consider the impact of JD prevalence on ability to reduce risks. Estimate the risk for spreading Johne's in the calving area: **Very Low Low Moderate High Very High**

Multiple animal use of the calving area was responsible for the highest percentage (22.5 percent) of the calving area's average total risk score, while nursing dam accounted for the lowest percentage (7.4 percent) of the calving area's average total risk score (figure 11).

Figure 11. For Dairy Operations, Percentage of Calving Area's Average Total Risk Score, by Risk Factor



Management plans

Results from the risk assessment were used to assist dairy producers in developing a management plan to reduce MAP transmission. Of the 70 enrolled dairy operations, 42 submitted a completed management plan. The majority of responding dairy operations (36 of 42) reported that their primary management plans were aimed at reducing calves' exposure to MAP by making changes in the calving area, colostrum management, or the feeding of milk to calves. Other management plans included removing test-positive animals and continuing to vaccinate calves.

Within-Herd Prevalence Estimates – Dairy Operations

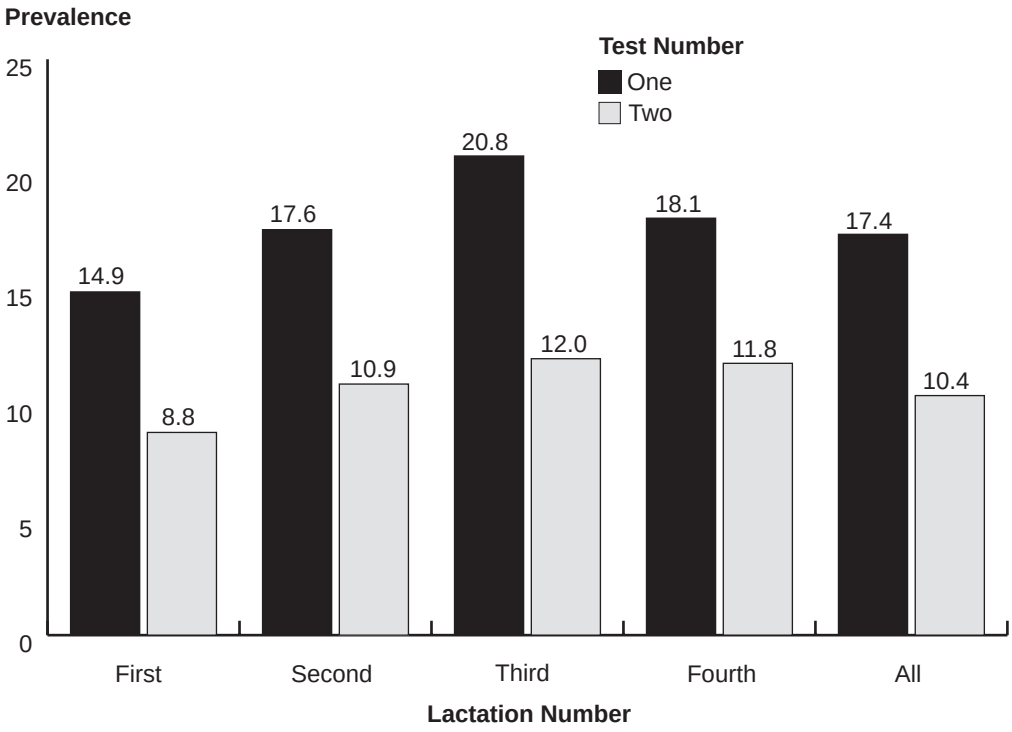
Rapid reduction of the prevalence of MAP infection may not be possible on many operations because the disease is chronic, has a long incubation period, and current diagnostic tests have a reduced ability (low sensitivity) to detect diseased animals. Even after implementing a solid management plan, reducing the prevalence of disease could take many years for infected operations. However, operations entering a testing and removal program may see a significant decrease in prevalence the first year as infected cattle are removed. Reducing within-herd prevalence of MAP depends on the level of a herd's initial MAP infection and the management practices implemented to reduce disease transmission.

Many of the dairy operations enrolled in the NJDDHP had been involved in a Johne's disease control program prior to 2003. To compare within-herd MAP prevalence over the total time enrolled in a control program, the first year of herd-level Johne's-disease testing information was set to year one for all participating operations, regardless of calendar year in which the testing occurred. The change in prevalence was assessed over time as more herd tests were completed. Since some operations had been tested more often than others, the number of operations represented in the prevalence estimate decreased as the number of test events increased. Management practices would most likely effect the first-lactation prevalence as uninfected animals entered the milking string.

Within-herd MAP prevalence for dairy operations via fecal culture and serum enzyme-linked immunosorbent assay (ELISA) are shown in figures 12 and 13, respectively. Test number represents the first and second times herd-level testing was reported, regardless of the year the testing occurred. Since many operations perform testing on a year-round basis, a prevalence estimate was calculated based on tests performed within each calendar year. Because testing strategies differ by operation (entire herd serum ELISA and fecal culture to serum ELISA with fecal culture confirmation of serum ELISA positive animals), only herds that tested at least 30 animals were included in the prevalence estimates.

Multiple culture methods including Herrold's egg yolk medium, BACTEC™, and TREK (ESP)® were used to test animals on participating operations. Results from all methods were used to determine overall prevalence. Within-herd prevalence determined via fecal culture decreased over all lactations for operations that tested at least twice (figure 12). The largest decrease in prevalence was observed in third-lactation cows (20.8 percent to 12.0 percent)

Figure 12. For Dairy Operations, Average Apparent With-In Herd MAP Prevalence (Via Fecal Culture), by Lactation Number and Test Number (n=27)

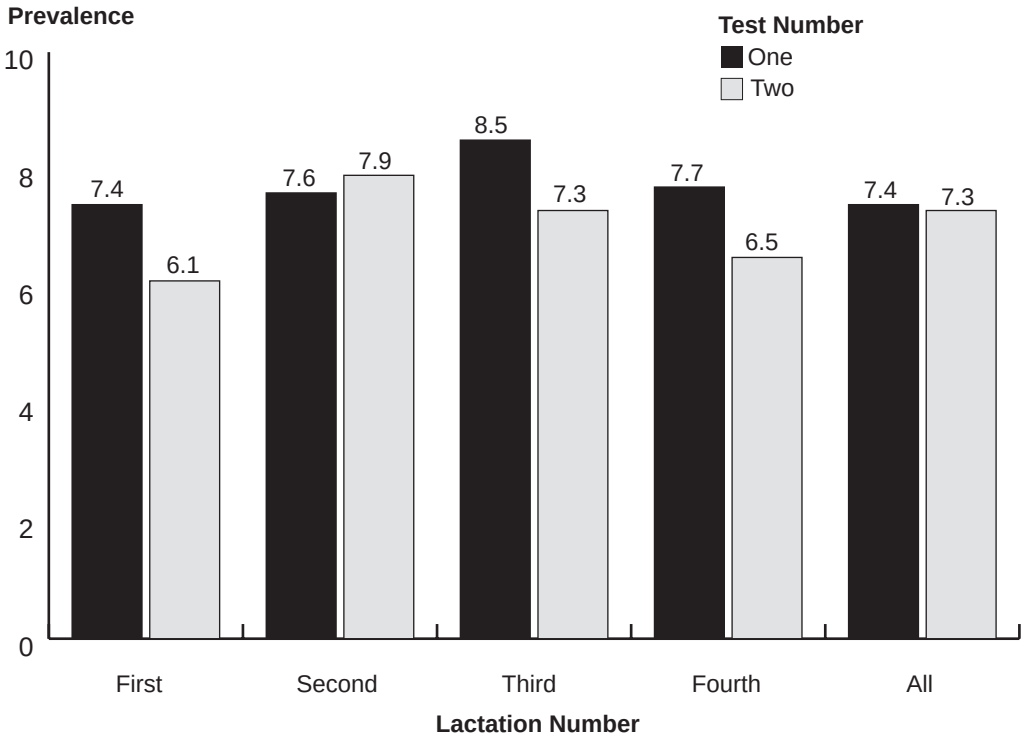


MAP seroprevalence estimates were calculated for all herds that performed serum ELISA. Since two commercial and two private ELISA kits/methods were used, the mean seroprevalence for all tests were compared. There were no significant differences among prevalence estimates, so all types of ELISA kits were combined in the analysis.

For animals on dairy operations where the lactation number was known, the overall mean MAP seroprevalence was calculated. There was a numerical decline in MAP seroprevalence for the first, third, and fourth (or more) lactation animals in herds that were tested at least twice (figure 13). The seroprevalence of animals in the second lactation increased slightly between test one and two (7.6 and 7.9, respectively). Seroprevalence for all lactations was essentially the same between the first and second test (7.4 and 7.3, respectively).

Prevalence estimates as determined by serum ELISA were approximately 50 percent less than estimates from fecal culture. Since the serum ELISA detects 35 to 50 percent of fecal-culture positive animals, the reduced apparent prevalence was predictable. There were also operations that used different test methods or testing strategies over time. The significant decrease in fecal culture prevalence compared to the nonsignificant decrease in seroprevalence is most likely due to removal of fecal-culture positive cows. Management plans from most operations included the removal of fecal-culture positive animals as soon as possible.

Figure 13. For Dairy Operations, Average Apparent With-In Herd MAP Prevalence (Via Serum ELISA), by Lactation Number and Test Number (n=32)



Summary

The NJDDHP is well into its second year. Data gathered during the project indicate that the preweaned calves management area on beef operations and the calving management area on dairy operations warrant continued monitoring. How new additions and replacements are selected on both types of operations also appears to be a critical area for monitoring. For operations with multiple years of testing information, MAP prevalence determined via fecal culture is decreasing at a quicker rate than MAP seroprevalence. Although a great amount of information has already been collected, over the next few years investigators will continue to provide data that should ultimately assist veterinarians and producers in reducing bovine MAP infection.

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